TEST UNIT FOR INTERFACE BETWEEN TELEPHONE COMPANY DEMARCATION POINT DEVICE AND CUSTOMER'S TELEPHONE SYSTEM

Field of the Invention

The present invention relates generally to telephone systems, and more particularly to detecting problems in telephone systems.

Background of the Invention

Many commercial telephone users employ a multi-line telephone system. Typically, such telephone systems permit multiple calls to be fielded at once; some systems employ switching devices and the like in order to enable a live or automated operator to handle incoming and outgoing calls smoothly. As an example, the MERIDIAN system, available from Nortel, has twenty-five separate lines for use by the customer.

The multi-line telephone systems described above are interconnected with telephone lines provided by a commercial local telephone company at a "demarcation point", which represents the location to which the local telephone company delivers telephone signals. The multi-line telephone system interfaces with a demarcation point device to provide service to the customer. One typical demarcation point device for interfacing with the customer's telephone system is an

RJ21X device, which provides connections for twenty-five telephone lines. The RJ21X device typically includes a connector, known in this field as an "amphenol" connector, that has twenty-five pairs of "tip and ring" pin connection sites aligned in stacked relationship, with one pin pair site corresponding to each telephone line. The mutli-line telephone system has a mating amphenol connector that interconnects with the amphenol connector of the RJ21X device, thereby connecting the telephone system with the local telephone company.

One problem that can develop as a result of this arrangement is identifying the cause of any malfunction to a telephone line. In many instances, the customer recognizes a problem with a line when attempting to use the telephone in the normal manner (for example, there may be no "dial tone" when the telephone is "off-hook"). When this occurs, the customer is often unable to determine whether the malfunction is present in the local telephone company's lines or in the customer's telephone system itself. As such, ordinarily the customer is forced to contact either the phone company or the vendor of the telephone system, who will send a representative to evaluate the problem. Too often, customer contacts the wrong party first, thereby subjecting itself to the cost of an unproductive, non-corrective service call and delay until the proper party is located. Also, in many instances the telephone system must be disconnected from the demarcation point, which can disable the entire telephone system.

In view of the foregoing, it would be desirable to provide a technique by which a customer can determine the source of a telephone line problem for a multi-line telephone system, and to do so without the need to disconnect the multi-line telephone system from the demarcation point device provided by the local telephone company.

Summary of the Invention

Embodiments of the present invention can assist a telephone customer to identify the correct party (local telephone company or vendor) to contact in the event of a telephone malfunction. As a first aspect, embodiments of the present invention are directed to a multi-line telephone system interface assembly, comprising: a local telephone company demarcation point; a multi-line telephone system; and a test unit. The demarcation point device includes a first connector that provides a plurality of connection sites, each of which delivers telecommunication signals corresponding to a respective telephone line. The multi-line telephone system is

configured to provide a plurality of telephone lines to users. The telephone system includes a second connector with a plurality of connection sites, the second connector being configured to mate with the first connector such that each of the connection sites of the first connector can be connected with a respective connection site of the second connector to provide a corresponding telephone line to a user. The test unit is connected between the first and second connectors. The test unit has a demarcation point connector that interfaces with the first connector and a telephone system connector that interfaces with the second connector. The test unit includes a plurality of switches, each of the switches being configured to selectively connect respective pairs of connection sites of the first and second connectors to provide a telephone line therebetween. The test unit further comprises an indicator that signals whether a designated connection site of the first connector is providing telecommunication signals to its corresponding telephone line. With this configuration, a repairman can determine quickly whether a problem with a telephone line is attributable to the equipment of the local telephone company or the telephone system, and can do so without the need to disconnect the telephone system from the demarcation point device.

As a second aspect, embodiments of the present invention are directed to a multi-line telephone system interface assembly, comprising a local telephone company demarcation point and telephone system as described above. A test unit is connected between the first and second connectors and has a demarcation point connector that interfaces with the first connector and a telephone system connector that interfaces with the second connector. The test unit includes a plurality of switches, each of the switches being configured to selectively connect pairs of connection sites of the first and second connectors to provide a telephone line therebetween. The test unit further comprises means for determining whether a connection site of the first connector is providing a dial tone to its respective telephone line.

As a third aspect, embodiments of the present invention are directed to a test unit for determining whether a local telephone company demarcation point device is providing telecommunication signals to one of a plurality of telephone lines of a telephone system. The test unit comprises: a demarcation point connector that is configured to interface with a connector of the demarcation point; a telephone system connector that is configured to interface with a connector of the telephone system; a plurality of switches, each of the switches being

configured to selectively connect a connection site of the demarcation point device with a corresponding connection site of the telephone system, the selective connection providing a telephone line therebetween; and an indicator that signals whether a designated connection site of the demarcation point device is providing telecommunication signals to its respective telephone line. As described above, such a device can be employed to determine whether a problem with a malfunctioning telephone line is attributable to the equipment of the local telephone company or the telephone system.

As a fourth aspect, embodiments of the present invention are directed to a test unit for determining whether a local telephone company demarcation point device is providing telecommunication signals to one of a plurality of telephone lines of a telephone system, the test unit comprising a demarcation point connector, a telephone system connector, and a plurality of switches as described above. The test unit further comprises means for determining whether a specified connection site of the demarcation point device is providing a dial tone to its respective telephone line.

As a fifth aspect, embodiments of the present invention are directed to a method of testing a telephone line for operability. The method comprises the steps of: connecting a local telephone company demarcation point and a multi-line telephone system with a test unit, the demarcation point device including a first connector that provides a plurality of connection sites, each of which delivers telecommunication signals corresponding to a respective telephone line, the multi-line telephone system configured to provide a plurality of telephone lines to users, the telephone system including a second connector with a plurality of connection sites, the second connector being configured to mate with the first connector such that each of the connection sites of the first connector can be connected with a respective connection site of the second connector to provide a corresponding telephone line to a user, the test unit connected between the first and second connectors, the test unit having a demarcation point connector that interfaces with the first connector and a telephone system connector that interfaces with the second connector, the test unit including a plurality of switches, a respective one the switches being configured to selectively connect a respective pair of connection sites of the first and second connectors to provide a telephone line therebetween, the test unit further comprising an indicator that signals whether a designated connection site of the first connector is providing telecommunication

signals to its corresponding telephone line; activating one of the switches to divert a telecommunication signal from one of the telephone lines to the indicator; and monitoring the indicator to determine whether the telecommunication signal is reaching the indicator.

Brief Description of the Figures

Figure 1 is an exploded view of an embodiment of the telephone system interface assembly of the present invention.

Figure 2 is a schematic diagram of the connection ports of an "amphenol" connector for use with the telephone system interface assembly of **Figure 1**.

Figure 3 is a schematic diagram of the telephone system interface assembly of **Figure 1** with the wiring of the test unit exposed.

Figure 4 is a schematic diagram of another embodiment of a test unit of the present invention in which light-emitting diodes (LEDs) are employed to determine whether a telephone line is in operation.

Detailed Description of Embodiments of the Invention

The present invention will now be described more fully hereinafter, in which embodiments of the invention are shown and described. This invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, like numbers refer to like elements throughout. Thicknesses and dimensions of some components may be exaggerated for clarity. It will be understood that when an element is referred to as being "connected" or "coupled" to another element, it can be directly connected or coupled to the other element or intervening elements may be present. In contrast, when an element is referred to as being "directly connected" or "directly coupled" to another element, there are no intervening elements present.

Referring now to the figures, a telephone system interface assembly, designated broadly at **10**, is illustrated in **Figure 1**. The system interface assembly **10** includes a local telephone

company demarcation point device **12**, a test unit **20**, and a telephone system **40**. These components are described in greater detail below.

Referring again to **Figure 1**, the local telephone demarcation point device **12** can be any of a number of demarcation points known to those skilled in this art. The demarcation point device **12** is configured to provide connection sites for a plurality of separate telephone lines. In some embodiments, the demarcation point device **12** is an RJ21X interface, available from Marconi Communications, which provides twenty-five separate telephone lines. Alternative demarcation point devices include an inside network interface (INI), a network interface device (NID), or an RJ48C data jack. The demarcation point device **12** includes a connector **14** that presents the connection sites for interconnection with a mating connector (such as the demarcation connector **30** or the connector **42** discussed below). In some embodiments, the connector is a so-called "amphenol" connector, which provides ports for twenty-five pairs of "ring and tip" connections (*see* **Figure 2** for a typical amphenol connector arrangement). Each of the connection sites corresponds to one of the telephone lines provided by the demarcation point device **12**.

Still referring to **Figure 1**, the telephone system **40** can be any multi-line telephone system recognized by those skilled in this art to be capable of receiving communication signals from the telephone lines provided by the demarcation point device **12** and processing them to produce multiple telephone lines for use. Exemplary telephone systems include the MERIDIAN system, available from Nortel, the ELECTRA system, available from NEC, the STRATA system, available from Toshiba, and the KX systems, available from Panasonic. The telephone system **40** includes a connector **42** having a plurality of connection sites that is configured to mate with the connector **14** of the demarcation point device **12** and receive therefrom communication signals for each of the telephone lines provided by the demarcation point device **12**; the telephone system **40** processes those signals to provide usable telephone lines to multiple users. As an example, if the connector **14** is of the amphenol type discussed above, the connector **42** should be a complementary amphenol connector. The configurations of the connector **14** and the connector **42** should be such that, if the connector **14** and the connector **42** were connected, the telephone system **40** would provide an operable telephone line for each telephone line provided by the demarcation point device **12**.

Referring once again to **Figure 1**, the test unit **20** connects with and bridges the demarcation point device **12** and the telephone system **40**. The test unit **20** includes a housing **22** (typically formed of a polymeric material) within and on which electronic components are mounted. The test unit **20** also includes a demarcation point connector **30** that is configured to mate with the connector **14** of the demarcation point device **12** (for example, if the connector **14** is an amphenol connector as described above, the demarcation point connector **30** should also have an amphenol configuration). In doing so, the connector **30** establishes connections for communication signals with each of the plurality of telephone lines provided by the demarcation point device **12**. On its opposite side, the test unit **20** includes a telephone system connector **32** that is configured to mate with the connector **42** of the telephone system **40**. The telephone system connector **32** establishes connections for communication signals with the telephone lines provided by the telephone system **40**. Under typical circumstances, the demarcation connector **30** and the telephone system connector **32** are complementary, as they connect the connector **14** of the demarcation point device **12** and the connector **42** of the telephone system **40** that ordinarily connect with one another.

Referring again to **Figure 1**, a plurality of "on-off" switches **24** are mounted to the housing **22** so as to be externally accessible. Each switch **24** corresponds to one of the plurality of telephone lines provided by the demarcation point device **12**. In the illustrated embodiment, each switch **24** is flanked by indicia **26** that denote the "on" or "off" position of the switch **24**. Other indicia, such as "open" and "closed", may be used.

Referring now to **Figure 3**, an exemplary embodiment of the switches **24** and accompanying wiring is illustrated. Each of a plurality of demarcation point lines **50** extends between the connector **30** and a switch **24**, thereby establishing a connection between the demarcation point device **12** and the switch **24**. Each of a plurality of telephone system lines **52** extends between a switch **24** and the connector **32** to establish a connection between the switch **24** and the telephone system **40**. Thus, when a switch **24** is closed (as in the upper portion of **Figure 3**), a telephone line connection is created between the demarcation point device **12** and the telephone system **40**. Each switch **24** is also connected with a test port line **54** that extends to a test port **28** and/or other indicator, as described below. When a switch **24** is closed (as in the

lower portion of **Figure 3**), the telephone line signal from the demarcation point device **12** to that switch **24** is diverted to the test port **28**.

Referring again to **Figure 1**, the externally-accessible test port **28** can, as illustrated, be a RJ-type port (such as an RJ-11 or RJ-45 port) that can accept a standard RJ-type plug (which would, in turn, be connected with a typical telephone handset). Alternatively, or in addition, the test port **28** can be any type of port or other indicator that can indicate whether communication signals (typically in the form of dial tone) are being provided by the demarcation point device **12**; examples include an LED responsive to the communication signals from the demarcation point device **12** or an audio speaker that projects the sounds provided by the demarcation point device **12**.

Usage of the test unit **20** can be as follows. The test unit **20** can be installed in the manner described, with the connector **14** of the demarcation point device **12** connected with the connector **30** of the test unit **20** and the connector **42** of the telephone system connected with the connector **32** of the test unit **20**. All of the switches **24** of the test unit **20** are moved to the "on" position, which establishes telephone line connections between the demarcation point device **12** and the telephone system **40**. The test unit **20** can be installed at initial installation of the telephone system **40** or can be retrofitted into an existing connection between the demarcation point device **12** and the telephone system **40**. The test unit **20** can remain in this condition for ordinary use.

When a telephone system user discovers a problem with a specific telephone line, a repairman (or even the user) can employ the test unit **20** to determine whether the problem is associated with the telephone system or with the local telephone company. The repairman can move the switch **24** that corresponds to the problematic telephone line to the "off" position. This action switches the telephone line of interest away from the telephone system **40** to the test port **28**. The repairman can then connect a telephone handset to the test port **28** to determine whether signals are being received (e.g., whether a dial tone is heard). If a dial tone is present, the problem likely lies with the telephone system **40**, at which point the telephone system service provider can be contacted for service. If there is no dial tone, the problem likely lies with the equipment provided by the local telephone company (i.e., the problem is located at the demarcation point device **12** or upstream therefrom), and the local telephone company can be

contacted for service. In this manner, the proper repair service can be identified immediately. Also, this assessment can be made without disconnecting the telephone system **40** from the demarcation point device **12**, which would cause the other telephone lines to become temporarily inoperable.

As noted above, the test unit **20** may also take alternative configurations, which operate on the same principles, but with somewhat different operation. For example, if an LED is employed as the indicator, when a switch **24** for a particular telephone line is moved to the "off" position, the LED may light if communication signals are received at the indicator and fail to light if they are not. Similarly, employment of an audio speaker as an indicator would cause the dial tone to be heard through the speaker once a switch was moved to the "off" position if communications signals were being received. Those skilled in this art will recognize other means for determining whether a connection site of the demarcation point device is providing a dial tone to its respective telephone line.

An additional embodiment for switches of a test unit is illustrated in **Figure 4**, which shows a telephone line **60**, a test switch **62**, and a pair of LED-resistor pairs **64a, 64b**. In this embodiment, when the telephone line **60** is not in use (i.e., it is "on-hook"), the LEDs **64a, 64b** are not illuminated. Use of the telephone line **60** completes the circuit defined by the telephone line **60**, thereby causing the LEDs **64a, 64b** to illuminate (such illumination can alert a repairman that the line **60** is in use). In the event that a portion of the telephone line **60** downstream of the switch **62** becomes grounded, the LED **64a, 64b** connected with that portion of the telephone line **60** will illuminate, thereby indicating the presence of the grounding of the telephone line **60** and on which portion of the telephone line **60** the grounded state is located. Use of the switch **62** to indicate other telephone line problems is as discussed above in connection with the switch **24** shown in **Figures 1-3**.

The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. As such, all such modifications are intended to be included within the scope of this invention. The scope of the invention is to be defined by the following claims.